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A COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM FOR THE MISSISSIPPI-SALT RIVERS BASIN

Public Health Service
Washington, D. C.

1954

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Water Pollution Series No. 65

A COMPREHENSIVE PROGRAM FOR WATER POLLUTION CONTROL

for the

MISSISSIPPI-SALT RIVERS BASIN

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

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FOREWORD

Our country's development over the past 50 years has been marked by tremendous progress in many fields. It has made possible great gains in the health, comfort, and well-being of the people. But it has not been without cost. Part of the cost has been the damage to the Nation's water resources that has resulted from wastes discharged to the streams by our growing cities and industries. All water uses have been affected--public water supplies, recreation, agriculture, industry, fish and aquatic life.

In enacting the Federal Water Pollution Control Act in 1948, the Congress declared that "water pollution has become a matter of grave concern in many areas and its damaging effects on the public health and national resources are a matter of definite Federal concern as a menace to national welfare. Abatement must be undertaken in order to control it."

The Public Health Service, as part of its responsibilities under this Act, is required to prepare or adopt, in cooperation with other Federal agencies, State and interstate water pollution control agencies, and municipalities and industries, comprehensive programs for the abatement of pollution.

This report contains the comprehensive water pollution control program for the Mississippi-Salt Rivers Basin of the Iowa State Department of Health, Illinois Sanitary Water Board, and the Missouri Department of Public Health and Welfare. The program is sound and gives full consideration to the several present uses and to the reasonably anticipated future uses of the waters of this basin. It provides an equitable balance in the pollution control requirements for various private and public groups concerned.

I am pleased, therefore, in my capacity as Surgeon General of the Public Health Service, to adopt the program developed by the State water pollution control agencies of Iowa, Illinois, and Missouri for the Mississippi-Salt Rivers Basin as a comprehensive program which fully meets the requirements of the Federal Water Pollution Control Act.

This program is based on beneficial water uses and related conditions that prevailed on January 1, 1954. Comprehensive programs for pollution control must necessarily be flexible. They must allow for growth, development, and changing conditions. Any significant changes affecting water quality, such as stream flow, water use, industrial development, population, etc., may require changes in the pollution control program.

Obviously the mere adoption of this program will not, in itself, reduce pollution or improve the usefulness of the waters in this basin. It does provide to the citizens of the area and to the city officials and industrial leaders, farmers, fishermen, conservationists, and others an objective plan based on good engineering practice, and reflecting sound economics. It is a plan which the public can support, and must support, if progress is to be made in the abatement of pollution.

Certain additional considerations beyond the mere acceptance of a plan are essential to its successful execution. The citizens of the areas affected must see that sufficient resources are provided to the State water pollution control agencies concerned to enable them to make the technical investigations to aid those responsible for constructing pollution abatement works.

We must recognize, too, that in order to be fully effective, the plans and programs of one State must be geared closely to those of adjoining States, since State boundaries are no barrier to pollution traveling in interstate streams. Above all, no program of this nature can progress beyond the report stage if its meaning and purpose are not made clear and understandable to the citizens of the area. In the final analysis, they are the ones who will pay, directly or indirectly, for the pollution abatement works that are needed.

It is my hope that this program for the Mississippi-Salt Rivers Basin will be carried through to completion so that the area may enjoy all the benefits that clean water can provide, in health and recreational opportunities for the people and in sound growth of industry and agriculture.

Leonard A. Scheele

Leonard A. Scheele
Surgeon General

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INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June 1948, requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies, and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary condition of surface and underground waters.

This report, prepared in cooperation with the water pollution control agencies of Iowa, Illinois, and Missouri, sets forth the water pollution control program being followed by the respective States in the Mississippi-Salt Rivers Basin. This program, which is based on data available as of January 1, 1954, was developed after a thorough consideration of the existing and potential uses of the water resources in the basin; the pollution entering the streams and the resulting damages; the benefits which may result from pollution prevention and abatement; and the prevention measures now in effect as well as those which are needed.

Agencies which cooperated in the preparation of this report included the Iowa State Department of Health, Illinois Sanitary Water Board, and the Missouri Department of Public Health and Welfare. Likewise, acknowledgment is made to the Corps of Engineers, Department of the Army; Soil Conservation Service, Department of Agriculture; Bureau of Census, Department of Commerce; Bureau of Mines, Fish and Wildlife Service, and Geological Survey, Department of Interior; and the Federal Power Commission for their review of the report and for the information obtained from their published reports.

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COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM
for the
MISSISSIPPI-SALT RIVERS BASIN

General Characteristics and Economic Development

The Mississippi-Salt Rivers Basin lies, for the most part, in northeastern Missouri with 16 percent in Illinois and less than 5 percent in Iowa. The basin contains 9,530 square miles of the Mississippi River watershed and is drained by several small rivers, including the Fox, Wyaconda, Fabius, North, Salt, Cuivre and Sny.

Steep limestone bluffs on both sides of the Mississippi River separate the flood plain from the upland area which is divided by a series of streams with fairly steep slopes that have eroded deep valleys. Little or no flow regulation exists in the basin and extreme low flows are experienced on many of the streams in late summer and early fall with no flow recorded at times for many of the streams. Sheet erosion and gullying have occurred in many sections of the basin and have removed the rich loess and glacial drift soils exposing the clay subsoils.

The basin has a temperate climate with monthly mean temperatures varying from 22° F. to 78° F. Approximately 60 percent of the annual 38 inches of precipitation falls during the 175-day growing season. Thunderstorms, which are common, result in sudden freshets. Prolonged droughts have been experienced, but are of rare occurrence.

The basin is predominantly rural, with grain farming gradually giving way to stock raising because grain farming has resulted in the deterioration of the soil. The present trend toward stock raising favors the return of some cultivated land to pasture and woodlots, particularly that subject to soil erosion. Manufacturing is limited in scope, with only Quincy and Hannibal having significant industrial development. Quarrying has developed into an important industry along the Mississippi River.

The 1950 population of the basin was 309,100, representing a six percent decrease from the 1940 census. Quincy, Illinois, with a population of 41,450, and Hannibal, Missouri, with 20,444 people, are the only large cities in the basin.

Water Use and Water Quality Objectives

Waters of the basin serve a variety of uses, such as municipal and stockwatering supplies, propagation of fish and wildlife, recreation, and navigation. About half of the basin's population is served by community water supplies; ninety percent receive water from surface sources, and 10 percent from wells.

Surface waters of the basin are used extensively for watering livestock, one of the basin's principal sources of income. The basin's waters also furnish recreational facilities for many people. Most of the streams are heavily fished, and the waters, particularly in the uplands and in the Mississippi River bottoms, serve as wildlife habitats. There are several recreational developments, State parks, and wildlife refuges in the area. Navigation is limited to the 135 miles of the Mississippi River included in the basin. Quite importantly, the basin's watercourses serve as final outlets for the wastes of its communities and industries.

It is recognized by water pollution control authorities that beneficial water uses require water of a particular quality. Water quality objectives have generally been used by the water pollution control agencies for many of the basin's water uses.

Water quality objectives as given in Public Health Bulletin 296, "Manual of Recommended Water Sanitation Practice," are used as a guide in determining the treatment requirements for pollution sources upstream from municipal water supply intakes. Quality objectives for the bacteriological quality of bathing waters recommended by the Joint Committee on Bathing Places (Joint study by the American Public Health Association and Conference of State Sanitary Engineers, covered in a report entitled "Recommended Practice for Design, Equipment, and Operation of Swimming Pools and Other Public Bathing Places," 1949), together with sanitary surveys, are employed in the administration of the basin's pollution control programs as related to bathing waters. Although quality objectives for water used for nonswimming recreation do not set forth

as high a bacteriological criterion, the same basic fundamentals are used by the States in their programs concerning these uses.

Water quality objectives for stockwatering have not been precisely defined, but the authorities agree that the elimination of such pollution as floating and settleable solids and high bacterial concentrations is desirable. For fishing waters, the general objectives advocated by the U. S. Fish and Wildlife Service, calling for a balanced aquatic life habitat and limiting concentrations of pollutional substances, are usually used by authorities in this basin. These and other water quality objectives used by the State agencies are discussed in somewhat more detail in the body of this report in the section entitled "Uses of Water Resources."

Sources and Effect of Pollution

More than 142,000 people--45 percent of the basin's population--live in communities which have sewerage systems. These systems serve a connected population of 110,000 and discharge wastes which, after treatment, are equivalent to that from a contrubutory population of 48,000. The amount, if any, of industrial waste being discharged to the watercourses in this basin has not been determined, but it is of minor significance from a pollution standpoint.

Five communities do not provide treatment for their wastes, but these communities have a combined sewered population of 6,040 which is only a small fraction of the sewered population of the basin. Twelve of the 28 existing municipal sewage treatment plans are considered to have inadequate capacity to handle the present load, however, and three are not operated satisfactorily.

At several places in the basin, the waters are damaged to some degree by pollution. Most damage is to water used for livestock, although damage to fish and aquatic life has been reported in some instances. Pollution may have increased the difficulty of providing a safe and palatable water in some of the basin's communities using surface water supplies. Pollution is damaging water quality for fish and wildlife propagation and has deteriorated recreational use in some streams. There are nine places in the basin where nuisance conditions are reported to exist and four additional places where the water is reported to be unsatisfactory for all indicated uses immediately below the source of pollution. For the most part, however, these pollution damages are localized, and only short stretches of the streams have been affected.

Progress in Pollution Abatement

The water pollution control agencies of the States are actively working on the pollution problems and are using existing authority in an effective manner. They work cooperatively with municipalities and industries in solving pollution problems and enforcing existing statutes. Their pollution control programs have resulted in sewage treatment being provided by 26 of the basin's 31 communities which have sewerage systems. The population served by the existing sewage treatment plants amounts to 95 percent of the basin's total sewered population.

At the present time, three communities are either actively planning new sewage treatment works or have plans approved for such facilities.

The water pollution control laws of Illinois and Iowa are adequate to abate existing pollution and to prevent or control new or increased sources of pollution. Missouri lacks comprehensive water pollution control legislation. Present Missouri statutes are limited in scope and pertain only to nuisances or to the effects of pollution on public health through public water supplies. The State water pollution control programs for this basin have been very successful, but in order for the State agencies to continue their effective and active programs, they must be furnished with adequate appropriations to enable them to attract and hold sufficient qualified personnel to carry on and expand their activities.

Pollution Prevention Measures Required

Excellent work has been done on the control of pollution within recent years, but there are still a number of projects that must be constructed before adequate control or prevention

is realized. Analysis of the available data which show stream characteristics, the amount of wastes discharged to the watercourses, present water quality in the streams, and existing water uses in relation to generally accepted water quality objectives, has enabled the determination of pollution abatement requirements for the major sources of pollution in the basin. To meet these requirements, five new sewage treatment plants for systems now without treatment and serving 6,040 people should be constructed. In addition, two new sewage treatment plants are needed to replace inadequate existing plants that are now serving a connected population of 5,800. Enlargements or additions are needed at ten existing plants now serving 13,365 people.

Some additional data will be required to completely determine the total pollution load from all municipalities and industries. However, the data now available will allow the continuation of the comprehensive programs for elimination of many of the pollution problems that now exist.

In Missouri, a serious deterrent to an aggressive water pollution control program is the lack of comprehensive water pollution control legislation. It is recommended, therefore, that officials of this State call this deficiency to the attention of the next State legislature with the recommendation that adequate legislation be enacted.

Water Pollution Control Program

The needed improvement measures discussed herein and listed below are based upon studies and observations by the responsible water pollution control agencies in the States concerned, which, in some cases, did not include an investigation of pollutional conditions in the receiving stream. They are recommended on the premises of providing treatment facilities where such facilities do not now exist and for expansions and improvements to existing facilities where they are now not entirely adequate to protect the stream under all conditions. Thus, the mere fact that they are included in the listing does not always indicate the existence of a pollutional condition in the stream which is seriously damaging to water use. Nevertheless, they are deemed advisable for restoring, preserving, or protecting the stream for all legitimate water uses including those that may now exist and those that may materialize in the foreseeable future.

The corrective measures listed below are flexible and are intended to reflect the needs for the present situation as it now exists; however, changes in stream characteristics, pollutional load, or water uses may require future revisions in the treatment needed.

The essential elements of the program as developed by the States concerned consist of the following:

1. Provide the following improvements:

Name and Location	Improvement Needed	Remarks
Bowling Green, Missouri	Enlargement of existing treatment plant	
Canton, Missouri	New treatment plant	
Centralia, Missouri	Enlargement of existing treatment plant	
Edina, Missouri North Plant	Additions to existing treatment plant	
South Plant	Additions to existing treatment plant	
Elsberry, Missouri	New treatment plant	
Kahoka, Missouri	Additions to existing treatment plant	Plans approved

Name and Location	Improvement Needed	Remarks
La Grange, Missouri	New treatment plant	
Louisiana, Missouri	New treatment plant	
Macon, Missouri	Replacement of existing treatment plant	
Moberly, Missouri East Plant	Additions to existing treatment plant	
Monroe City, Missouri	Replacement of existing treatment plant	Active planning
Moulton, Iowa	Additions to existing treatment plant	
Palmyra, Missouri	Additions to existing treatment plant	Plans approved
Paris, Missouri	New treatment plant	
Troy, Missouri	Additions to existing treatment plant	
Warrenton, Missouri	Additions to existing treatment plant	

2. Operate all existing and future waste treatment works at a uniformly efficient and high level in order to obtain maximum benefits from these facilities and permit their most effective utilization.

3. Continue the policy of requiring adequate treatment of wastes from new sources and expanded use of existing facilities, in order to preclude new pollution problems.

PHYSICAL DESCRIPTION

The Mississippi-Salt Rivers Basin consists of the drainage area tributary to the Mississippi River from a point 229 miles above the mouth of the Ohio River to a point 135 miles farther upstream. A number of small watersheds make up the basin and, with the exception of the Mississippi River itself, there are no large streams in this basin. The main streams on the west side of the Mississippi River are the Fox, Wyaconda, Fabius, North, Salt and Cuivre Rivers. The Sny River and Bear Creek are the principal streams discharging from the east. The basin contains a total area of 9,530 square miles of which 7,560 are in Missouri, 1,550 in Illinois, and 416 in Iowa.

Steep limestone bluffs, covered with rich soil deposits, form prominent lines on both sides of the river and separate the Mississippi flood plain from the upland area. The upland area, ranging from steep hills and rolling country to level prairie, is covered with a glacial drift soil that is of fair-to-good quality for agriculture. This upland area is drained by a series of streams which have cut deep valleys and emerge from the bluffs at more or less regular intervals. The hills and rolling land were originally covered with a dense oak and maple forest which extended over about 90 percent of the basin area, and the remaining 10 percent, mostly in the level uplands, was covered with prairie grasses. Unwise clearing and overgrazing resulted in severe sheet erosion and gullying in many sections of the basin.

The upland prairie lands are underlain in many places with tight clay and clay-loam subsoils. These sub-soils reduce percolation and increase surface run-off which results in increased erosion. The rich loess and glacial drift soils have been washed away in several places in the uplands, leaving the clay sub-soils exposed at the surface.

The Wyaconda, Salt, Fabius and Cuivre Rivers have fairly uniform gradients throughout, with slightly steeper gradients near their headwaters. The slope of the Salt River averages about 1½ feet per mile. These streams rise at elevations from about 600 to 720 feet above sea level and discharge into the Mississippi River at elevations of approximately 400 to 440 feet above sea level. Profiles of the streams in the Sny River basin, on the east side of the Mississippi River, are similar. The Mississippi River passing through this basin is controlled by Lock and Dam Projects Numbers 20 through 26 and has a total drop of 61 feet through these projects.

The climate of the basin is continental in nature with average January temperatures ranging from about 22° F. in the extreme north to about 28° F. in the south. Corresponding average July temperatures range from 75° F. to 78° F. Precipitation over most of the basin averages about 38 inches per year, about 60 percent of it falling during the frost-free growing season of about 175 days. Long rainy spells are unusual, but heavy local rains in late spring and early summer may amount to as much as 10 inches in 24 hours. The average annual snowfall is about 20 inches and the ground is covered with one or more inches of snow approximately 40 days each year.

Stream flows of all of the rivers of the basin, including the Mississippi River, tend to be erratic. Many of the streams have very low or practically no flow during parts of the year, and many of these same streams have very high flows at other times. For instance, the North River has had a maximum flow of 27,400 cubic feet per second during flood stage and has had no flow for periods ranging up to 30 days, while the Cuivre River has recorded flows ranging from no flow to 120,000 cubic feet per second. Stream flow data for these and other rivers of the basin are given in the following table. It will be seen that the streams of the basin have extended periods of extremely low flows and that none of them had an average flow during the driest record month exceeding .23 cubic feet per second. These critical low flows generally occur in late summer or early fall, except in the Mississippi River where winter is the critical season.

STREAM FLOW DATA AT VARIOUS LOCATIONS IN THE
MISSISSIPPI-SALT RIVERS BASIN

River and Gaging Station	Drainage Area in Sq. Mi.	Years of Record	River Discharge in Cubic Feet Per Second			
			Average	Maximum	Minimum	Average During Driest Month
Fox River at Wayland, Mo.	400	21	212	25,000	0	.02
Wyaconda River at Canton, Mo.	393	18	229	17,700	0	0
North Fabius R. at Monticello, Mo.	452	27	277	17,400	0	0
Middle Fabius R. at Baring, Mo.	185	15	109	9,540	0	.02
South Fabius R. at Taylor, Mo.	620	15	377	19,700	0	0
North River at Palmyra, Mo.	373	15	255	27,400	0	0
Salt River at New London, Mo.	2,480	28	1,674	58,700	0	.18
Hadley Creek at Kinderhook, Ill.	73	11	59	15,000	0	.09
Bay Creek at Nebo, Ill.	162	11	115	23,500	0	.11
Cuivre River at Troy, Mo.	903	28	731	120,000	0	.23

ECONOMIC DEVELOPMENT

Seventy percent of the basin's people live in Missouri, 26 percent in Illinois, and 4 percent in Iowa. Population figures for the Iowa-Missouri portion of the basin show a steady decline from 268,543 in 1900 to 229,857 in 1950, while the population of the basin as a whole decreased from 327,200 in 1940 to 309,100 in 1950. A few of the urban communities, of which Quincy, Illinois, and Hannibal, Missouri, are the largest, show a slow growth while the population of other towns and of the rural area has steadily decreased. Population density in the basin is 32 persons per square mile, with densities varying from 12 persons per square mile in that portion of Calloway County, Missouri, located in the basin, to 104 persons per square mile in the basin portion of Randolph County, Missouri. A third of the population (115,200) is urban, with 41,450 living in Quincy and 20,444 in Hannibal. There are three other cities with populations over 10,000 and five communities with populations between 2,500 and 5,000. Twenty communities have populations between 1,000 and 2,500, and 18 have populations between 500 and 1,000.

Because a grain system of farming resulted in the present deteriorated condition of the soil, recent farming trends are toward stock raising. This trend favors the return of some cultivated lands to pasture and woodlots, particularly those subject to soil erosion;

this change, in addition to keeping the soil on the farms where it can be used, will also keep it out of the streams where it causes pollution.

Manufacturing in this basin is limited, with only Quincy and Hannibal being outstanding in industrial development. Shoes, clothing material and fabricated metal are among the principal products. Quarrying is an important industry along the Mississippi River. Limestone, structural clay and allied products are the principal materials produced.

The average effective buying income for the basin was approximately $1,070 per capita in 1950 and ranged from $624 in Calhoun County, Illinois, to $1,348 in Adams County, Illinois. The national average for the same year was $1,311.

- DOMESTIC WATER SUPPLY
- INDUSTRIAL WATER SUPPLY
- LIVESTOCK
- COMMERCIAL FISHING
- GAME FISHING
- WILDLIFE
- OTHER RECREATION
- NAVIGATION

MISSISSIPPI - SALT RIVERS BASIN

EXISTING PRIMARY WATER USES

U S DEPARTMENT OF
HEALTH EDUCATION AND WELFARE
Public Health Service

MAP NO 1

USES OF WATER RESOURCES

Important uses of the basin's waters include domestic supply, livestock supply, sport and commercial fishing, wildlife, bathing and other recreation, and navigation. The primary use is, in many cases, domestic water supply, but the predominant use throughout the basin is livestock supply. Navigation is limited to the Mississippi River.

The twenty-three communities in this basin which obtain their public water supplies from surface sources had a 1950 population of approximately 135,000 and supplied 111,000 consumers with 8,500,000 gallons of water per day. Four of these communities secure their supply from the Mississippi River, while the other 19 take their water directly from the smaller streams or have constructed impounding reservoirs to supply their needs. Underground water supplies are used by twenty communities which supply 15,900 people with 730,000 gallons of water per day.

In judging the quality of finished water for domestic supply, consideration is given to the quality of the source water. Therefore, source water quality objectives are among the factors considered in determining treatment requirements for pollution sources upstream. In determining the suitability of water sources for domestic supply in this basin, State health and water pollution control officials use Public Health Bulletin 296, "Manual of Recommended Water Sanitation Practice," as a guide.

The most common use of water in this basin is for livestock watering. Cattle and hogs are raised extensively throughout the basin, and the majority of the farmers use the streams and small ponds as a source of water for their stock. Water quality objectives for stockwatering have not been precisely defined, but the authorities agree that the elimination of such pollution as floating and settleable solids and high bacteria concentrations is necessary to provide water quality satisfactory for stock use.

The quantity of surface water used by industry for cooling or process purposes, with or without treatment, is not known, but several industries make use of the Mississippi River for their water supply. Because of the diversity of uses, quality requirements for industrial water supplies vary widely; no specific criteria can be adopted, as each case must be considered separately. Of general concern, however, are the organic and biological constituents, toxic substances, and properties of corrosion, encrustation, and slime formation of the available waters.

The main streams and their tributaries are used for recreational purposes including swimming, fishing, boating, cabin sites, camping and picnicking. Sport fishing is popular in the portion of the Mississippi River covered by this report, and commercial fishing on the river is a substantial industry. Many of the major flyways for migratory fowl pass over this basin, and the waters are very important to these birds.

Contamination of bathing waters by sewage, especially that of recent origin, is objectionable, as water for recreational usage should be free from floating solids, sludge banks, odors, and discoloration. Quality objectives for the bacteriological quality of bathing waters recommended by the Joint Committee on Bathing Places (Joint study by the American Public Health Association and Conference of State Sanitary Engineers, covered in a report entitled "Recommended Practice for Design, Equipment, and Operation of Swimming Pools and Other Public Bathing Places," 1949), together with sanitary surveys, are employed in the administration of pollution control programs as related to batning waters of the Salt River Basin. Although quality objectives for water used for non-swimming recreation do not set forth as high a bacteriological criterion, the same basic fundamentals are used by the States in their programs.

The U.S. Fish and Wildlife Service has set forth certain water criteria for fresh-water fish which are used by the States in their water pollution control programs. General objectives call for a balanced aquatic biota and limiting amounts of pollutional materials. Sludge beds, silt sedimentation and other deposits which tend to blanket the stream bottom or destroy the biological life are highly undesirable.

Navigation in this basin is confined to the Mississippi River. Although there are no large port facilities in the area, considerable traffic passes through this basin. Due to the

irregular flow now available in the basin streams, power development is not, at present, an important water use.

All of these water uses are considered essential for the improvement of the economic conditions, health and welfare of the people in the basin, and conservation of the water resources is necessary for the continued development of the area. As a conservation measure, wastes discharged to the watercourses must be treated so as to achieve the pertinent water quality objectives and maintain the waters in a suitable condition for the indicated water uses.

POLLUTION CONTRIBUTED TO WATER RESOURCES

Pollution in the Mississippi-Salt Rivers Basin is confined almost entirely to that caused by municipal wastes from the 31 municipalities which have sewerage systems serving a connected population of 109,945. The strength of the waste discharged from 30 of these is equivalent to that from a population of 48,585. This figure includes the waste from five municipalities with a combined sewered population of 6,040 that are discharging untreated sewage to the streams.

TABLE A
SEWERED MUNICIPALITIES*

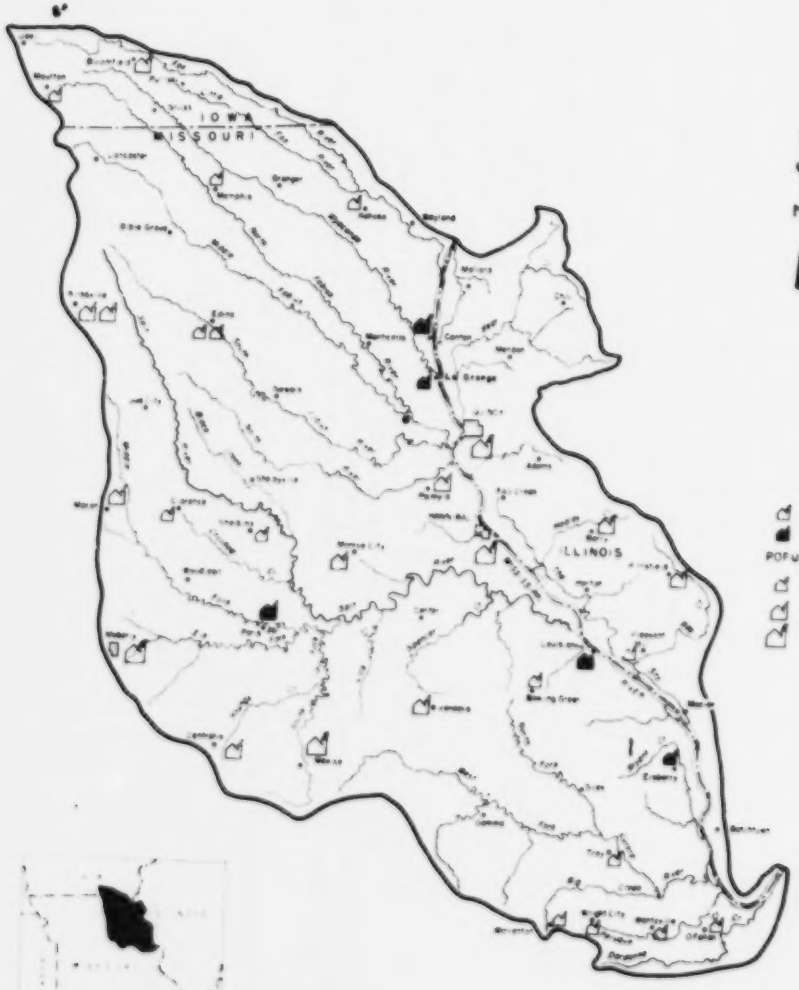
Municipalities*	Number	Population Served by Sewerage System	Amount of Pollution Discharged to Watercourse (In terms of equivalent number of people)
Having data on pollution load discharged to watercourse	30	108,845	48,585
Having population data available (data on pollution load to watercourses incomplete or not available)	1	1,100	not applicable
TOTAL	31	109,945	xxx xxx

* Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers; sanitary sewage wastes discharged by industry directly to watercourse and industrial wastes discharged into municipal sewerage systems.

In addition to the municipal wastes discharged to the waters, there may be some industrial wastes originating at industries with separate waste sewers that discharge directly to the basin's waters. Any such separate waste discharges that do exist are not of sufficient magnitude at present to be brought to the attention of pollution control authorities.

Twenty-six of the 31 communities with sewerage systems provide treatment for their wastes. The five communities that do not provide treatment have a combined population served of 6,040 and discharge untreated sewage directly to the watercourses. The major portion of the basin's pollution load is discharged as partially treated sewage from the 12 sewage treatment plants that have inadequate capacity to treat the wastes from their present connected population load of 19,165. Considerable pollution is created by three communities, serving approximately 20,000 people, which are not operating their sewage treatment plants to obtain a satisfactory degree of treatment.

The main sources of damaging pollution in this basin are the small communities that are discharging untreated or inadequately treated wastes to streams which have little or no flow during critical periods. Approximately 50 percent of the total pollution load being discharged to the basin's waters is entering the Mississippi River which has sufficient dilution capacity to assimilate that pollution without appreciable damage.



SOURCES OF POLLUTION

MUNICIPALITIES WITH TREATMENT FACILITIES

MUNICIPALITIES WITHOUT TREATMENT FACILITIES

POPULATION SERVED BY SEWERS

1,000 AND UNDER

1,001 - 5,000

OVER 5,000

MISSISSIPPI - SALT RIVERS BASIN

MUNICIPAL SOURCES OF POLLUTION AND EXISTING TREATMENT FACILITIES

U. S. DEPARTMENT OF
HEALTH EDUCATION AND WELFARE
Public Health Service

DAMAGES TO WATER RESOURCES FROM POLLUTION

In certain areas pollution has caused damage to legitimate water uses. The amount of damage varies with the degree of pollution and depends upon the extent to which the major existing water uses are affected and potential water uses are held in abeyance by unsatisfactory water quality. Water use damages result from bacterial pollution, deoxygenation by organic pollution, toxicity, increased hardness, chloride content, or the presence of color, odor, or taste-producing substances. Where nuisance conditions exist, all existing water uses along the stream for some distance below the source of pollution are damaged and other uses are prohibited by the excessive pollution load with which the stream is burdened.

Nuisance conditions are reported to exist for short distances below the municipal waste outfalls of Kahoka, Edina, Paris, Moberly, Monroe City, and Warrenton, Missouri. In every case the water use destroyed by this nuisance condition consists of livestock watering, the support of wildlife, or fishing and other forms of recreation. The same water uses have been adversely affected, although not so seriously, in the streams immediately below the outfalls of Macon, Centralia, Bowling Green, and Elsberry, Missouri. In many cases, the intangible hazard to public health is just as important as the obvious damage to specific water uses.

Over 85 percent of the people served by municipal water supplies use water that is secured from surface sources. When this surface water is highly polluted, an increased burden is placed on the water plant operators to insure that a safe, palatable water is produced at all times. Where the bacterial load in the raw water is high, a very close watch must be maintained at all times to insure that there is no breakdown of water treatment facilities and sterilization equipment, as failure of vital equipment might allow the discharge of inadequately treated water to the city mains.

When used for domestic or industrial supply, surface waters which are badly polluted by sewage or industrial waste require expenditures of funds in addition to those normally required for adequate treatment since chemical consumption and consequently operating costs will increase. In some cases, additional equipment will be required in order to produce a satisfactory water.

Water used by industry must meet quality standards dependent upon the plant processes involved. Boiler water must be soft and non-corrosive; food canning requires a high quality water with a minimum of dissolved solids; dairy products plants require water free of taste, odors, and harmful bacteria; bottling plants need a water free of tastes and odors and of organisms which might develop aftergrowths. When the source water of an industry is polluted, it must expend substantial funds on treatment processes to insure water of required quality.

Livestock watering, the predominant use made of the basin's waters, is reported to be frequently damaged by pollution. The damage involves the complete loss of the use of the water in the more grossly polluted areas and a potential hazard to the stock in the form of toxic materials or disease organisms in other polluted areas.

Sports fishing has also suffered from pollution. In cases of heavy pollution where nuisance conditions prevail, and even in the cases of mild pollution in those areas where stream flows are materially reduced at times of minimum flow, fish propagation is made difficult if not impossible. This damage causes loss to the sportman in the form of increased time and expenditures needed for traveling to waters where fishing is possible. In cases where time or finances do not permit the longer travel made necessary by pollution of nearby waters, the complete loss of the recreational opportunity afforded by fishing or water sports is of considerable importance to the individual and community. Recreational use of the basin's waters is not practiced as frequently as it might be if pollution were eliminated.

Possible damage to property values should not be overlooked when assessing the cost of pollution damage. Condition of the available water is an important factor when locating on or near a watercourse, or when developing waterfront property. There is little doubt that property values have suffered some loss due to pollution in those areas where nuisance conditions exist in this basin, but no data are available to indicate the extent of such damage.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

Pollution abatement facilities cost money, but the cost is generally well justified considering the long-range benefits which accrue. Preserving and improving the surface waters as sources of public water supply is of specific benefit in this basin because of the extent of this use. Monetary benefits will result from the production of safe and potable water at minimum treatment costs, and expenditures required to develop new surface water supplies will be smaller if high quality waters are available.

Preserving and improving the basin's waters for agricultural use is of considerable benefit because of the important place agriculture has in the economy of the entire area. A good quality water supply that is palatable and free of disease organisms is essential for healthy animals and profitable livestock farming.

Pollution control will assure increased and continued benefits from recreational use of the basin's waters. Abatement of pollution will aid in promoting more extensive development of these resources, and prevention of future pollution will assure continued use. Wider development of the water resources for recreational use will reduce travel distances from population centers to desirable fishing, recreational, and boating sites, and will result in reduced costs and increased recreation time. This benefits all of the basin's people, but it is especially beneficial to those residing in urban areas that do not have outdoor recreational facilities close at hand.

Water pollution in this basin is not widespread, but is acute in certain localities. Abatement of existing pollution will restore the damaged water uses, and the prevention of additional pollution will preserve the water for future uses. The basin's water resources are vital to its continued prosperity, and expenditures made to preserve them will be a sound investment.

POLLUTION PREVENTION MEASURES IN EFFECT

The fact that twenty-six of the 31 basin communities which have sewer systems provide treatment for their wastes is evidence of the progress the State agencies have made in solving this problem. These 26 communities serve 95 per cent of the total sewered population in the basin.

TABLE B
EXISTING MUNICIPAL* TREATMENT FACILITIES

Degree of Treatment Provided	Number of Municipalities	Number of Plants	Population Served
Primary	9	10	72,125
Secondary	17**	18	31,780
No Treatment	5	--	6,040

* Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers, industrial wastes discharged into municipal sewerage systems.

** Includes three municipalities with a combined population of 5,290 which are served by plants providing intermediate treatment.

Sixteen existing municipal sewage treatment plants are considered to have adequate capacity to handle the present waste load and 24 plants are reported to be operating satisfactorily. Twelve existing sewage treatment plants, however, are reported to have inadequate capacity and do not give the degree of treatment which may ordinarily be expected from such plants. Active planning is now underway to provide sufficient capacity and facilities at some of the plants now considered unsatisfactory in this respect.

TABLE C
ADEQUACY OF EXISTING MUNICIPAL TREATMENT FACILITIES

Number of Treatment Facilities	Adequacy of Capacity			Adequacy of Operation		
	Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
28	16	12	0	24	3	1

The twelve municipal sewage treatment plants which are considered to have inadequate capacity are now serving a combined population of 19,165, or about 18 percent of the sewered population. The inadequate capacity of some of these plants is due to the fact that they have been in service for a long period of time during which the load has increased to such an extent that they can no longer handle it. Other plants provide primary treatment only, whereas present downstream water use requires a water quality that can be obtained only through secondary treatment. The basin's first sewage treatment plant was constructed in 1911; approximately 20 percent of the plants are now at least 30 years old, and over half of them are more than 20 years old. Nine municipalities have constructed new plants or made major improvements to their existing plants since 1940, two of these being constructed in 1949 and one in 1951.

All of the watershed area in the States of Iowa and Illinois, and approximately 50 percent of the area in Missouri, is now organized in Soil Conservation Districts. The Soil Conservation Service, working through these districts, provides technical assistance to the farmers in installing conservation practices, such as contour farming, contour strip cropping, terracing, and improved rotations. All of these practices definitely tend to reduce the sediment loads of the streams in these watersheds, thus reducing costs of filtering public water supplies, damage to fish life, silting of reservoirs and stream channels, and damage to agricultural land.

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The work that has been and is being done to control pollution is most encouraging, but there are points on the streams in this basin where additional control work is needed. As already indicated, the large number of existing plants and the number of communities which have treatment plant plans approved and ready for construction illustrates the excellent job that the State water pollution control agencies are doing. However, the activities of the agencies are hampered by lack of sufficient trained personnel and sufficient appropriations to properly expand their activities to meet the increasing problems that confront them. It will be necessary to provide adequate appropriations if efficient, well-operating pollution control organizations are to be maintained at a level that will permit continued progress in pollution abatement.

The water pollution control laws of Illinois and Iowa are adequate to abate existing pollution and prevent or control new or increased sources of pollution. The water pollution control agencies of these two States have been given sufficient legal authority to carry on their programs, and they have used this authority judiciously and effectively. Missouri lacks comprehensive water pollution control legislation; present statutes are limited in scope and pertain only to nuisances or to the effects of pollution on public health through public water supplies. However, a high degree of stream pollution control has been effected by the responsible Missouri agencies without benefit of a comprehensive State pollution control law. The following brief analysis presents the salient features of water pollution control legislation of the States of the basin.

In Illinois, control of water pollution is vested in the Sanitary Water Board under the Act of 1951, which superseded the Act of 1929. The Board has the authority to carry on comprehensive water pollution control programs, adopt rules and regulations, hold hearings, issue orders, and to recover money sufficient for restoration of fish life which has been destroyed as a result of the violation of the Act. The law also provides other penalties for violation of the Act and enables the Board to control or prevent new or increased sources of pollution.

The 1951 Act includes provisions for requirement of certification of municipal sewage treatment plant operators as well as industrial waste treatment plant operators. The Sanitary Water Board Act does not apply to any existing sanitary district having a population of one million or more. There is some overlapping of jurisdiction between the Sanitary Water Board and the Conservation Department, which protects fish and wildlife from pollution. Pollution originating from oil fields comes under the jurisdiction of the Department of Mines and Minerals.

In Iowa, the water pollution control act vests the principal authority in the State Department of Health, although the Iowa Natural Resources Council and State Geologist also have certain functions relating to water pollution. The Iowa Natural Resources Council makes surveys of health and pollution problems relating to flood control and the State Geologist is responsible for protection of waters from pollution by oil and gas wells.

There is no specific statutory authority granted to the State Department of Health to develop a comprehensive program, to set standards of water purity, or to classify waters. However, the Department is authorized to exercise general supervision over public health, promote public hygiene and sanitation, to investigate and prevent water pollution, and to make necessary rules. The Department is authorized to issue written permits, after approval of plans and specifications, for new sewerage or industrial waste systems as well as extensions or additions which would substantially increase water pollution.

The Department may hold public hearings on water pollution and may order abatement of pollution. However, the order cannot be issued without the written approval of a majority of the members of the Iowa Natural Resources Council. Penalties are provided for violations of orders issued or for unlawful pollution of State waters.

There are no exemptions from the operation of the Act since removal in 1949 of the restrictions under which the authority of the Department did not apply to border streams. The last amendments to the existing statutes of the State of Iowa considerably strengthen previous water pollution control legislation, under which a large measure of progress was made. Disposal of garbage and night soil into streams or on land subject to overflow is prohibited by an old statute not under direct administration or enforcement by the State Department of Health.

Missouri has no comprehensive water pollution control law. This is a serious deterrent to an aggressive water pollution control program in this basin. Water pollution control in Missouri is administered by the Division of Health of the Department of Public Health and Welfare, which is limited to studies of the causes and prevention of diseases. The Director of the Department has the power to make inquiries and investigations on matters pertaining to health, and to hold hearings as may be necessary, and has the authority to subpoena witnesses and administer oaths.

No statutory authority exists for the development of comprehensive programs or for the issuance of permits or the review of plans and specifications. There is no specific statutory authority for enforcement, but rules and regulations or procedures established by the Division must be followed and obeyed; the person neglecting or refusing to do so is guilty of a misdemeanor.

It is a misdemeanor for any person to cause deleterious substances to be placed, run or drained into any of the waters of Missouri in quantities sufficient to injure, stupefy, or kill fish. However, it is not a violation for any person engaged in industry to cause or permit any waters subject to his control or used in such industry to be discharged under such precautionary measures as have been specifically approved by the Conservation Commission.

Formal orders for the abatement of pollution have seldom been used as an administrative procedure in this basin. Instead, water pollution control agencies of the States have preferred to use a cooperative approach, working closely with municipalities and industries in an attempt to secure abatement without exercising police powers.

Illinois and Iowa have a policy of not issuing permits for the construction of new sewer systems or extensions of existing ones unless the community requesting the permit has, or is actively planning to construct, adequate treatment facilities. Missouri does not issue formal permits for sewer construction, but has followed the practice of discouraging the construction of sewers or sewer extensions unless adequate treatment facilities are available or are being planned.

POLLUTION PREVENTION MEASURES REQUIRED

To obtain maximum utilization of the waters of the Mississippi-Salt Rivers Basin, sewage and industrial wastes discharged to the watercourses must be treated so that water of suitable quality is provided for the legitimate water uses. In view of the extensive use of surface water as a source for municipal water supplies and the importance of surface water to agriculture, the quality of these waters should be maintained at the high level necessary for these uses in order to stimulate the greatest growth and advancement of the whole basin.

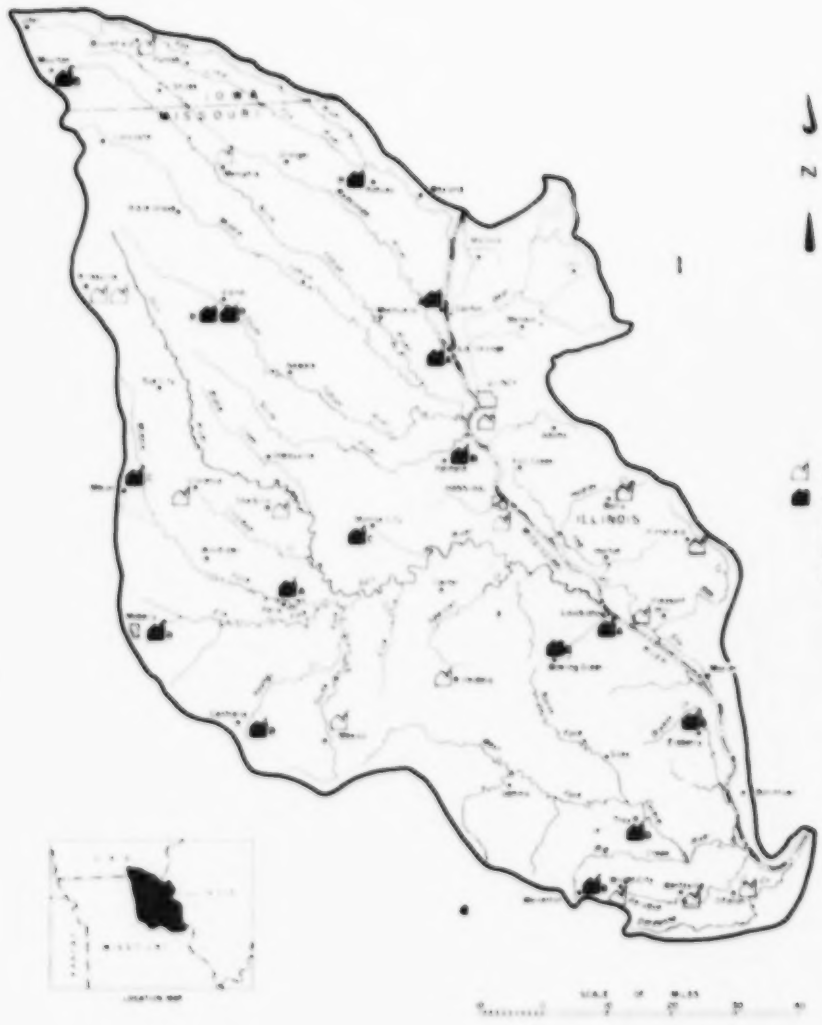
Water quality objectives which are pertinent to this basin have been discussed in the section of this report entitled "Uses of Water Resources." For much of the basin, the degree of treatment required is influenced by the amount of dilution water available during periods of critical low flow which for some streams may be zero. During low flow periods which occur in hot weather, the water temperature rises and reduces the capacity of the stream to absorb and hold oxygen, and at the same time accelerates the rate of biological activity with a corresponding increase in the amount of oxygen required to stabilize the organic material in the waste. Thus, where the quantity of waste discharge is large or where very little dilution water is available, undesirable stream conditions are accentuated.

It seems reasonable to expect that a high degree of treatment will be essential at those points where stream flows are critical in order to keep residual loadings within the stream's capacity for assimilation or to prevent nuisance conditions. To insure that treatment facilities will satisfy the requirements and to safeguard the taxpayers' investment, the State water pollution control agencies of Illinois and Iowa require the submission of plans fo. approval before construction is undertaken. The water pollution control agency of Missouri also approves plans for sewage treatment plants.

Prevention and corrective pollution control measures have been determined from results of stream surveys and other readily available data of the State agencies concerned. Construction of presently needed facilities and the adoption of waste prevention measures as soon as possible will restore, preserve, and protect existing legitimate water uses and those which may materialize in the immediate future. Required control measures were determined only after a thorough consideration of all water uses and are considered to be reasonable and adequate. At the same time, it should be kept in mind that the corrective measures are intended to be flexible and to reflect the needs of the existing situations. Changes in stream characteristics, pollutional load, or water use may require revisions in the indicated required treatment at some future date.

Excellent progress has been made in the basin in providing municipal waste treatment plants, but some additional plant construction, replacement and expansion are needed before all waters of the basin are adequately protected from the effects of pollution. There is also a need for improved operation at two of the plants. Failure to operate waste treatment works at the maximum efficiency for which they were designed results in failure to obtain clean streams as estimated and partial waste of funds spent in anticipation of clean streams.

Presently available information shows that 16 existing municipal sewerage systems with a total connected population of 84,740 are considered to be adequate for present conditions. No additional treatment facilities are required for the communities served by these systems.



MISSISSIPPI - SALT RIVERS BASIN

MUNICIPAL POLLUTION ABATEMENT NEEDS

U S DEPARTMENT OF
HEALTH EDUCATION AND WELFARE
Public Health Service

MAP NO 5

TABLE D
REQUIREMENTS FOR MUNICIPAL WASTE
TREATMENT PLANTS

Requirements	Number	Population Served by Facilities
New plant	5	6,040
Enlargement or Additions to Existing Plant	10*	13,365
Replace Existing Plant	2	5,800
No Project Required	16*	84,740

* Includes one municipality with two plants.

Five new sewage treatment plants are needed to serve an estimated total of 6,040 persons. Two existing sewage treatment plants, because of age or gross overloading, can no longer provide a satisfactory degree of treatment and should be replaced. These plants are now serving a total sewered population of 5,800. In addition, there are ten existing municipal sewage treatment plants, now serving an estimated population of 13,400, which should have additions or enlargements so that they can do an adequate job of controlling stream pollution.

TABLE E
STATUS OF MUNICIPAL TREATMENT WORKS
PROJECTS TO ABATE POLLUTION

Status of Project	Number of Projects
No Formal Action	10
Plans under Preparation	1
Final Plans Approved	2
Status Undetermined	4

Table E presents the currently available information on the status of municipal projects to abate water pollution in this basin. One community is actively planning improvements and two have progressed to the point where their treatment plant plans have been approved by the State water pollution control authorities. The progress that four communities are making is undetermined, while it is known that ten communities have taken no formal action to correct the pollution caused by their wastes.

Intensification of State water pollution control educational programs is important to long-range planning and good administration by water pollution control agencies. The undesirable effects of pollution on public health and water conservation must be presented to the public if its support of water pollution control measures is to be expected. Responsible officials, of both municipalities and industries, must become acquainted with expected treatment needs so that the needed improvements can be planned for well ahead of the time when these needs become an actuality and before damage to the waters has occurred.

APPENDIX
BASIC DATA ON SOURCES OF MUNICIPAL* POLLUTION
MISSISSIPPI-SALT RIVERS BASIN

Name and Location	Population Served by Sewers	P. E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		P. E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
				Capy.	Opr.			
MISSISSIPPI RIVER:								
Canton, Mo.	1,200		None	---	---	1,200	New Plant	Undet.
La Grange, Mo.	240		None	---	---	240	New Plant	Undet.
Quincy, Ill.	41,450	37,000	Primary	Sat.	Sat.	18,000	None	
Hannibal, Mo.	18,200		Primary	Sat.	Unsat.	11,800	None	
Louisiana, Mo.	2,500		None	---	---	2,500	New Plant	Undet.
FOX RIVER:								
Bloomfield, Iowa	2,000		Secondary	Sat.	Sat.	500	None	
BRUSH CREEK:								
Kahoka, Mo.	375		Primary	Unsat.	Sat.	240	Additions	Final Plans Approved
NORTH FABIUS RIVER:								
Moulton, Iowa	540		Intermediate	Unsat.	Unsat.	100	Additions	Undet.
Memphis, Mo.	650		Secondary	Sat.	Sat.	30	None	
SOUTH FABIUS RIVER:								
Edina, Mo. North Plant	750		Primary	Unsat.	Sat.	525	Additions	Inactive
South Plant	750		Primary	Unsat.	Sat.	525	Additions	Inactive

Name and Location	Population Served by Sewers	P. E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		P. E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
				Capy.	Opr.			
NORTH RIVER:								
Palmyra, Mo.	1,300		Primary	Unsat.	Sat.	900	Additions	Final Plans Approved
THE SNY; HANDLEY CREEK:								
Barry, Ill.	1,500		Secondary	Sat.	Sat.	150	None	
SIX MILE CREEK:								
Pleasant Hill, Ill.	850		Secondary	Sat.	Sat.	85	None	
BAY CREEK:								
Pittsfield, Ill.	3,600		Secondary	Sat.	Sat.	360	None	
SALT RIVER; STEER CR.:								
Kirksville, Mo. (North Plant)	3,000		Secondary	Sat.	Sat.	300	None	
BEAR CREEK:								
Kirksville, Mo. (South Plant)	2,800		Secondary	Sat.	Sat.	280	None	
CLEAR CREEK:								
Clarence, Mo.	750		Intermediate	Sat.	Sat.	110	None	
Shelbina, Mo.	1,100		Secondary	Sat.	Undet.	Undet.	None	
MIDDLE FORK SALT RIVER:								
Paris, Mo.	1,200		None	---	---	1,200	New Plant	Inactive
BRUSH CREEK:								
Macon, Mo.	4,000		Intermediate	Unsat.	Sat.	600	Replacement	Inactive

Name and Location	Population Served by Sewers	P. E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		P. E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
				Capy.	Opr.			
ELK FORK RIVER:								
Moberly, Mo. (East Plant)	5,500		Primary	Unsat.	Sat.	3,600	Additions	Inactive
SOUTH FORK SALT RIVER:								
Mexico, Mo.	6,200		Secondary	Sat.	Sat.	900	None	
GOODWATER CREEK:								
Centralia, Mo.	1,500		Secondary	Unsat.	Sat.	400	Enlargement	Inactive
INDIAN CREEK:								
Monroe City, Mo.	1,800		Primary	Unsat.	Unsat.	1,400	Replacement	Act. Planning
SPENCER CREEK:								
Vandalia, Mo.	1,500		Secondary	Sat.	Sat.	70	None	
NOIX CREEK:								
Bowling Green, Mo.	650		Secondary	Unsat.	Sat.	60	Enlargement	Inactive
BRYANTS CREEK:								
Elsberry, Mo.	900		None	---	---	900	New Plant	Inactive
CUIVRE RIVER:								
Troy, Mo.	1,000		Primary	Unsat.	Sat.	700	Additions	Inactive
BIG CREEK:								
Warrenton, Mo.	1,000		Primary	Unsat.	Sat.	800	Additions	Inactive

Name and Location	Population Served by Sewers	P. E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		P. E. (B.O.D.) Discharge to Watercourse	Treatment Needs	Current Status Municipal* Action
				Capy.	Opr.			
PERUQUE CREEK:								
Wright City, Mo.	240		Secondary	Sat.	Sat.	20	None	
Wentzville, Mo.	600		Secondary	Sat.	Sat.	60	None	
BR. OF PERUQUE CR.:								
O'Fallon, Mo.	300		Secondary	Sat.	Sat.	30	None	

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

** Includes industrial wastes discharged into municipal sewerage systems.